

AD-A009 790

ATOMIC AND MOLECULAR PROCESSES

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Prepared for:

Army Research Office - Durham
Advanced Research Projects Agency

24 February 1975

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARO-11427.2-P	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ATOMIC AND MOLECULAR PROCESSES		5. TYPE OF REPORT & PERIOD COVERED Final - 7/1/73-6/30/74
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Manfred A. Biondi		8. CONTRACT OR GRANT NUMBER(s) DAHCO4-73-C0037
9. PERFORMING ORGANIZATION NAME AND ADDRESS Depts. of Chemistry and Physics University of Pittsburgh Pittsburgh, Pa. 15260		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project No. 11427-P ARPA Order No. 2686
11. CONTROLLING OFFICE NAME AND ADDRESS Advanced Research Projects Agency 1400 Wilson Boulevard Arlington, Virginia 22209		12. REPORT DATE February 24, 1975
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Research Office Box CM, Duke Station Durham, N. C. 27706		13. NUMBER OF PAGES 7
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE NA
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release: Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) DDC RECEIVED MAY 20 1975		
18. SUPPLEMENTARY NOTES The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) lasers, ion-molecule reaction rates, metal atoms, chemiexcitation, metastable species, excited states, electron-ion recombination, infrared emission, energy transfer processes, air species, fuel-oxidizer reaction, optical discrimination		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The research topics carried out under the present contract are stated and references are given to the publications of the scientific findings resulting from the research. The personnel supported by the contract are listed.		

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ADA009790

ATOMIC AND MOLECULAR PROCESSES

ARPA Order No. 2686

Proposal 11427-r

Final Report

by

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February 24, 1975

For Period 1 July 1973 - 30 June 1974

The Advanced Research Projects Agency

DAHC04-73-C0037

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Pittsburgh, Pa. 15260

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I. Summary of Research

During the period of the present contract, July 1, 1973 to June 30, 1974 research was carried out in the following areas of atomic collisions and upper atmosphere studies:

A. Laboratory and Theoretical Studies

1. Laser Ion-Molecule Reaction Rates
2. Metal Atom Chemiexcitation
3. Excited State Production by Electron-Ion Recombination
4. Processes Involving Metastable Species
5. Infrared Emission from Energy Transfer Processes of Air Species and from Fuel-Oxidizer Reactions
6. Radiative Properties of Simple Molecules for Optical Discrimination

B. Atmospheric Studies

1. Particulate Detection Technology
2. Optical Interferometer Studies of the Upper Atmosphere
3. Measurement of the Ionized and Neutral Constituents of the Atmosphere

The progress in these researches has been summarized in detail in the semi-annual Technical Progress Summary Reports Nos. 16 and 17.

II. Research Publications Produced under the Contract

The following is a list of the scientific publications which set forth the results of the research under this contract:

PUBLICATIONS

Threshold Behavior of Inelastic-Scattering Cross Sections, J. N. Bardsley and R. K. Nesbet, Phys. Rev. A8, 203, 1973.

Auger Spectra of Highly Ionized Oxygen and Fluorine, B. R. Junker and J. N. Bardsley, Phys. Rev. A8, 1345, 1973.

Complex Coordinate Studies of Resonant Electron-Atom Scattering, R. A. Bain, J. N. Bardsley, B. R. Junker and C. V. Sukumar, J. Phys. B: Atom. Molec. Phys. 7, 2189, 1974.

Mobilities of Mass-Identified Atomic Ions in the Noble Gases, R. Johnsen, M. T. Leu and Manfred A. Biondi, Phys. Rev. A8, 2557, 1973.

Studies of Non-Resonant Charge Transfer Between Atomic Ions and Atoms, R. Johnsen, M. T. Leu and Manfred A. Biondi, Phys. Rev. 8, 1808, 1973.

6300A Intensity Variations Produced by the Arecibo Ionospheric Modification Experiment, Dwight P. Sipler, E. Enemark and Manfred A. Biondi, J. Geophys. Res. 79, 4276, 1974.

A Useful Extremum Principle for the Variational Calculation of Matrix Elements, E. Gerjuoy, A. R. P. Rau, L. Rosenberg and Larry Spruch, Phys. Rev. A9, 108, 1974.

Useful Extremum Principle for the Variational Calculation of Matrix Elements II, E. Gerjuoy, L. Rosenberg and L. Spruch, submitted to the Journal of Mathematical Physics.

Second Order Error in Variational Calculation of Matrix Elements, submitted to Journal of Mathematical Physics.

Absolute Rate Constant for the O + NO Chemiluminescence in the Near Infrared, M. F. Golde, A. E. Roche, and F. Kaufman, J. Chem Phys. 59, 3953, 1973.

Publications - cont'd.

Kinetics of the Reactions of N_2H^+ , N_4^+ , and N_3^+ with H_2O in the Gas Phase,

V. M. Bierbaum and F. Kaufman, J. Chem. Phys. 61, 3804, 1974.

Vibrational Emission of NO_2 from the Reaction of NO with O_3 , M. F. Colde
and F. Kaufman, Chem. Phys. Letters 29, 480, 1974.

Lifetime of the Metastable $^5S^0$ State of Atomic Oxygen, W. C. Wells and
E. C. Zipf, Phys. Rev. A 9, 568, 1974.

The Excitation of the CO Fourth Positive System by the Dissociative Recombination of CO_2^+ Ions, R. A. Gutcheck and E. C. Zipf, J. Geophys. Res. 78, 5429, 1973.

Electrical Detection of Airborne Particulates Using Surface Ionization
Techniques, Wade L. Fite and R. L. Myers, accepted for publication in
Environmental Science and Technology, 1975.

An Automatic Real-Time Detector and Sizer for Submicron Airborne Particulate
Matter, Wade L. Fite, R. L. Myers and T. M. Barlak, submitted to the
Review of Scientific Instruments, January 1975

A New Computer Controlled Quadrupole Mass Spectrometer System, Wade L. Fite,
M. A. Hender, R. L. Myers and Y. P. Chong, to be published.

III. Personnel Supported by this Contract

The following personnel have received partial or total support under this contract:

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